



AWARENESS AND ACCEPTABILITY OF DISRUPTIVE INNOVATIVE PRACTICES AMONG HEALTHCARE PROFESSIONALS IN A TERTIARY CARE TEACHING HOSPITAL IN INDIA

Medical Science

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ABSTRACT

Background: Providing safe and quality health care while optimizing resources at a reasonable cost has been firmly established as a significant challenge. In order to overcome these challenges, health care organizations need to continuously upgrade and adopt Disruptive Innovative Practices.

Materials and Methodology: A semi-structured questionnaire was given to all Clinicians and Hospital Administrators which had four segments namely Demographic profile, Awareness, Acceptability and Perceived benefits of Innovative Practices. The significance of association between Innovative Practices and awareness and its acceptability because of perceived benefits was established using SPSS ver 20.

Results: The response rate was 88.33%. The overall Awareness was good for ICT and Robotic surgeries whereas Acceptability was good for ICT and Cloud computing which reiterates the fact that people prefer to focus on what is important to them in the present scenario.

Conclusion: If an organization does not optimally use the current resources, or forgoes investment in technology, it may perform below an idealized potential.

Implications: This study provides foresight information about obtaining information regarding end-user acceptability before investing in Disruptive Innovative Practices thereby maximizing the chances of successful integration of technology with the organizational requirements.

Level of evidence: By paying attention to these new technologies we can better inform the development of adoption techniques by identifying those Innovative Practices which are acceptable.

KEYWORDS

Awareness and acceptability; Disruptive innovative practices; Tertiary care teaching hospital; Healthcare.

INTRODUCTION:

The disease burden faced by Indian health sector globally is 20%. Drawing on adoption of Disruptive Innovative practices to improve the quality and safety of care at reasonable price while optimizing resources has been firmly established as a significant challenge for healthcare managers.

There is an enthusiasm among healthcare professionals to adopt Disruptive Innovative Practices in order to improve quality of care and service efficiency. However, this has not always been matched by awareness and acceptability of those in practice. Healthcare organizations have to effectively manage quality, costs, safety and outcomes in order to serve the distinct purposes of healthcare i.e. treatment, diagnosis, prevention and outreach. At the core are the needs of patient and healthcare professionals. An innovation is said to be successful when it focusses on how the patient is seen, heard and how his needs are met. (1)

Introducing these practices within complex organizations like healthcare is not a straightforward linear process. Rather it is dynamic in nature, wherein the technological, social and organizational dimensions gradually align over time. However, healthcare is, when compared to other industries, slow to adopt technology. (2) Hence there is a need to understand the awareness and acceptability of innovations among healthcare professionals.

Innovation

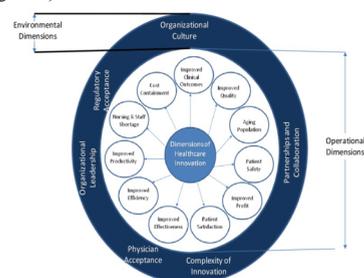
Innovation can be defined as the intentional introduction and application within a role, group, or organization, of ideas, processes, products or procedures, new to the relevant unit of adoption, designed to significantly benefit the individual, the group, or wider society. (1)

Innovation can be categorized by its impact on stakeholders as Nondisruptive or Disruptive. Nondisruptive also referred to as incremental, evolutionary, linear, or sustaining, improve on something that already exists but in a way that allows expanded opportunities to be met, or existing problems to be solved. Disruptive innovations, also called revolutionary, transformational, radical or nonlinear, refer to innovations that disorder old systems, create new players and new markets while marginalizing old ones, and deliver dramatic value to stakeholders who successfully implement and adapt to the innovation. (3)

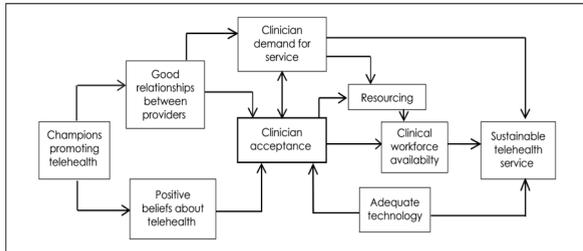
Indian health sector is poised to grow because of rising incomes and affordability, growing elderly population, rise in medical tourism, better awareness of wellness, preventive care and diagnosis, a national health insurance mission to cover entire population, use of modern technology and rising FDI and private sector investments. (4)

Key to our current framework is the assignment of factors to a specific phase: pre-implementation, implementation, or post-implementation, and the comprehensive and integrative nature of them, including thematic threads of people, process, and technology-related factors that connects the factors. (5) This study was focussed on the pre-implementation stage where 20 Disruptive Innovative Practices were chosen and the stake-holders were involved in order to find out their awareness and acceptance level and the perceived benefits.

There are two principal dimensions of healthcare innovation i.e. operational and environmental. (Fig 1) These dimensions motivate or affect the introduction of innovation in healthcare organizations. The operational dimension includes the improvement of clinical outcomes, efficiency, effectiveness, aging population, nursing shortage, patient satisfaction, profitability, patient safety, improved quality and cost containment. The environmental dimension includes physician acceptance, organizational culture, regulatory acceptance, and partnerships and collaborations. (1) This study included the physician acceptance/Clinician acceptance as the dimension for the conduct of the study. (Figure 1)



A study carried out by Wade VA et al proposed that Clinician acceptance is the key factor or the most important influence on the successful operation of innovations. It occupies the central position in the model. (Fig 2) By Clinician acceptance, authors mean the willingness of Clinicians to use innovation as an option for service delivery, either by taking up the innovation or working within an existing practice.(6) Therefore Clinicians acceptance becomes critical in determining the degree to which Innovative Practices are able to grow and become sustainable as the core processes are Clinician driven. (Figure 2)



Objectives

1. To study the awareness and acceptability about Disruptive Innovative Practices among Healthcare Professionals in a tertiary care teaching hospital.
2. To study the demographic differences in responses, if any.
3. To identify the perceived benefits of the Innovative Practices if they are to be adopted.

MATERIALS AND METHODOLOGY

The study was conducted in a tertiary care teaching hospital in Pune, Maharashtra which is been established for more than 70 years. A descriptive, cross-sectional study was used to carry out the study among Faculty and Residents of the college between Jan and Mar 2019. A minimum sample size of 96 was determined for the study using the formula for estimation of sample sizes for descriptive studies. The computation was based on 40% prevalence of the awareness and acceptability among the healthcare professionals of the hospital, an error of margin of 0.05%, *design effect (DEFT) = 1.5*, and non-response rate of 20%.

The maximum sample size we took was $p = 0.5$, $q = (1-p)$ and $d = 0.1$. The sample size was calculated using the formula:

$$n = \frac{Z_{1-\alpha/2} pq}{d^2} \text{ i.e. } \frac{3.84 \times 0.5 \times 0.5}{0.1 \times 0.1} = 96$$

Study participants were randomly selected from both the categories using a stratified sampling method proportionate to size. Thereafter 120 questionnaires were distributed to 75 Residents and 45 Faculty.

Though, the sample size calculated was 96 and the sample size we took for the study was 106. Total of 73 Clinicians and 33 Para-clinicians which included Hospital administrators were part of the study. For the development of research instruments, prior relevant studies were reviewed to ensure a comprehensive list of measures was included. All measures for each construct were included from the previously validated instruments and then modified according to the healthcare context.

The questionnaire included four parts. The first part included five questions capturing the demographic data of the respondents such as age, gender, job profile, job experience and specialty. The specialties were classified into Medicine and allied, Surgery and allied, Diagnostics and Para-clinical. The second and third part included the Awareness and Acceptability of the Disruptive Innovative Practices respectively. The fourth part included the perceived benefits if the respondents had to accept the Innovative Practices. One question in the last segment was open ended to seek suggestions, if any.

The reliability analysis of the questionnaire was carried out by using SPSS ver 20. The Cronbach's alpha for Awareness was 0.806, Acceptability was 0.824 and for Perceived benefits was 0.783. The questionnaire was pretested by peers who were not related to the study for its appropriateness and consistency. We conducted a pilot study where the questionnaire was administered to 13 colleagues and necessary amendments were made before distributing to the respondents. As a result, the study questionnaire demonstrated high content validity and reliability.

Innovative Practices

The study included Disruptive Innovative Practices of importance to various specialties in order to get holistic inputs. For example, Physician order entry and cloud computing of significance to Physicians and Intensivists, DaVinci and other Robotic surgeries to Surgery and allied specialties, PDR Brachytherapy to Radiation Oncologists, G scan MRI to Radiologists, Personalized Medicine and Genomics to Biochemists and Pharmacologists, and Tele Medicine and ICT to Hospital administrators. The list of practices included in the study are as below:

1. Personalized Medicine/Genomics
2. Retail Clinics
3. Telemedicine/Telehealth
4. Tele-Ophthalmology
5. Information Communication Technology
6. Web based Physician Order Entry
7. Mhealth
8. Cloud Computing
9. Internet on Things
10. Pulse Dose Rate Brachytherapy
11. Proton Therapy
12. High Intensity Focused USG
13. 320 Slice CT Scan
14. G-Scan MRI
15. Digital Mammography
16. DaVinci/LASIK
17. Robotic Renaissance surgeries
18. Robotic Trans Oral Surgery
19. Cyber Knife
20. True Beam STx System

RESULTS AND DISCUSSION

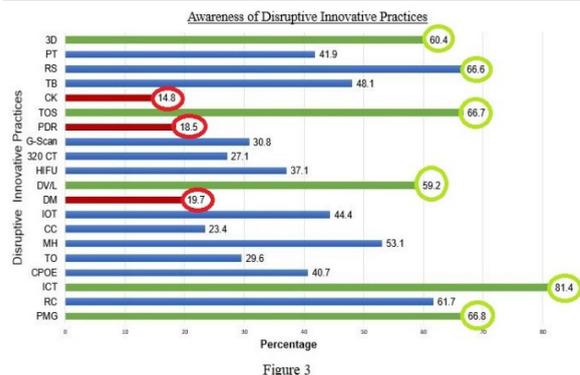
The study hospital is a busy 1082 bedded super specialty tertiary care teaching hospital. Out of the 120 distributed, a total of 106 were returned completed from 67 Residents and 39 Faculty members giving the response rate to 88.33%. Total of 73 Clinicians and 33 Para-clinicians including Hospital administrators were part of the study.

The study hospital is a busy 1082 bedded super specialty tertiary care teaching hospital. A total of 106 respondents took part in the study. As shown in the (Table 1) out of 106 respondents, most of the respondents i.e. 41 (38.68%) were below 35 years of age, 31 (29.24%) in between 36 to 45 years and the remaining 34 (32.08%) were more than 45 years (table 1) i.e. the respondents of other two groups were around 30%. Male respondents were 76 (71.69%) as compared to 30 females (28.31%), which is representation of faculty and staff gender distribution. Resident doctors were 67 (63.21%) as compared to the faculty 39 (36.79%).

The total of 51 respondents out of 106 having job experience of less than 10 years participated in the study (48.11%). 25 respondents had the job experience between 11 to 20 years and 30 of them had the experience of more than 20 years i.e. 28.31%. The demographic data also showed that the respondents among all the four categories of specialties participated almost equally. The total respondents of Medicine and allied were 27, 21 were of Surgery and allied, 25 of Diagnostics and Para-clinical respondents were 33. This could be attributed to the inclusion of various Disruptive Innovative Practices in the questionnaire relevant to each category. (Table 1)

Table 1 Participant demographic data (N=106)

Measure	Category	Numbers	% Out of 106
Age (Years)	< 35	41	38.68
	36-45	31	29.24
	> 45	34	32.08
Gender	Male	76	71.69
	Female	30	28.31
Job Profile	Faculty	39	36.79
	Residents	67	63.21
Job Experience (Years)	< 10	51	48.11
	11 – 20	25	23.58
	> 20	30	28.31
Speciality	Medicine & Allied	27	25.47
	Surgery & Allied	21	19.81
	Diagnostics	25	23.58
	Para-Clinical	33	31.14



Awareness

The overall awareness as shown in the (Fig 3) was relatively high for ICT (81.4%), Personalized Medicine (66.8%), Robotic surgeries (66.7%) and surprisingly for 3D Printing awareness was 60.4% whereas it was poor for PDR Brachytherapy (18.5%), Cyber Knife (14.8%) and Digital Mammography (19.7%). These findings disclose the fact that the awareness has not increased over time. Therefore, it may be reasonable to conclude that these Disruptive Innovative Practices may not have been an issue for the majority of the respondents. Most people prefer to focus on what is important to them

Table 2

Sr No	Demographic data	Variable	Size	Percentage	Innovative Practice	p-value
1	Age	<35 years	(n=41)	38.68%	-	-
		36-45 years	(n=31)	29.24%	3D Printing	0.039
		>45 years	(n=34)	32.08%	-	-
2	Gender	Males	(n=76)	71.69%	Tele-Ophthalmology	0.002
		Males	(n=76)	71.69%	320 Slice CT	0.009
		Females	(n=30)	28.31%	G-Scan MRI	0.026
		Females	(n=30)	28.31%	PDR Brachy	0.025
3	Job-profile	Faculty	(n=39)	36.79%	Tele-Ophthalmology	0.008
		Residents	(n=67)	63.21%	MHealth	0.041
4	Job-experience	< 10 years	(n=51)	48.11%	-	-
		11-20 years	(n=25)	23.58%	3D Printing	0.025
		>20 years	(n=30)	28.31%	Tele-Ophthalmology	0.017
		>20 years	(n=30)	28.31%	Digital Mammography	0.005
5	Specialty	Medicine & allied	(n=27)	25.47%	ICT	0.032
		Surgery & allied	(n=21)	19.81%	ICT	0.041
		Para-clinicians	(n=33)	31.14%	ICT	0.020
		Surgery & allied	(n=21)	19.81%	Da-Vinci	0.009
		Medicine & allied	(n=27)	31.14%	PDR Brachytherapy	0.005

The Faculty was found to be associated with more aware of Tele-Ophthalmology (p value 0.008) than Residents. This could be attributed to their higher experience. The respondents with job experience of more than 20 years were more aware of Tele-Ophthalmology (p value of 0.017). This could be attributed to the time savings per visit i.e. more than two hours per actual visit thereby making the time available for other important and preferred activities by a virtual visit. This finding corresponds with the study carried out by Kruse et al (8)

Males were found to be more associated with 320 Slice CT (with p value 0.009). This could be attributed to a study carried out by Goswami et al which carried out a Structural Modelling Analysis and found that statistically significant differences exist in adoption of new technologies between male and female with respect to three relations i.e. between ease of use and perceived usefulness, between perceived usefulness and attitude and between intention of use and actual behaviour.(9)

Interestingly this study showed that females were more aware of G-Scan MRI (with p value of 0.026). Various studies have revealed that claustrophobia is more likely in women than men. A study was carried out to evaluate whether MR scanners with acoustic noise reduction and a short magnetic bore reduce the rate of claustrophobic reactions. This study revealed that women were significantly more likely than men to experience claustrophobia during MRI. (10) Another study also showed the similar findings as in the claustrophobic event rate was higher in females than in males during MR imaging. (11) Therefore

in the present scenario. (Figure 3)

Given continued low awareness of, but considerable growing interest in Innovative Practices, an awareness should be created among various stake holders. This will need an applied information and technical assistance to effectively and efficiently use the latest and most appropriate Innovative Practices. The broad-based approach should be aimed at end users, opinion leaders in order to successfully implement these Innovative Practices.

The association of demographic factors with awareness of Disruptive Innovative Practices is shown in table 2. The age group of 36 to 45 years was associated with awareness of 3D printing (p value 0.039). The respondents having job experience of 11 to 20 years (p value 0.025) were associated with awareness of 3D Printing (Table 2). Both the categories go hand in hand with each other. This could be attributed to the growing quest of knowledge in both the categories in order to be up-to-date with the current trends in research.

Males were more aware of Tele-Ophthalmology than females (p value 0.002) attributing to its top benefits of anytime, anywhere accessibility. The innate nature of males to consult a patient by video while traveling, or working from home office which can be done with just a smartphone or laptop. This study correlates with another study carried out by Foster et al where the females declined the idea of telehealth. (7) (Table 2)

this could be attributed to the revolutionary tilting open MRI being ergonomically designed where the patient can sit, stand or lie down and has been a boon for the Claustrophobics.

Females were also more aware of PDR Brachytherapy (with p value of 0.025). This could be attributed to the satisfactory results of regression of gynaecological cancers and even tumour healing with less toxicity to adjacent normal tissues with the invent of PDR Brachytherapy which is considered a very safe technique. (12)

Residents were aware of MHealth than Faculty (with p value of 0.041). The findings of this study are in consonance with the study carried out by Kate Hampshire et al. It reveals that mobile phones are becoming an important part of young people's health-seeking repertoires and has the potential to be an important therapeutic resource. These young people are not waiting passively for MHealth to come to them. They are already doing m-health informally using mobile phones creatively and strategically to try to secure healthcare.(13)

The respondents with job experience of more than 20 years were more associated with Digital Mammography than other two groups (with p value of 0.005). This could be attributed to the exposure which comes with the experience. More experience broadens the knowledge network and gives insight into the increasingly important upcoming technologies providing quality care to the patients. More awareness campaigns being conducted by the innovative companies as a part of their corporate social responsibility. Active participation by the experienced seniors in the public sector will be a critical step in

creating awareness and exchange of technologies. (14)

The specialty wise analysis revealed that all specialties were significantly aware of Information and Communication technology. The Medicine and allied, Surgery and allied and Para-clinical were significantly aware of ICT with p value of 0.032, 0.041 and 0.020 respectively. A similar research was carried out by Westbrook et al where the research focused on ICT as a potential disruptive innovation that challenged the way in which healthcare is delivered. The study addressed a significant problem of harnessing ICT to create new and effective model of service delivery which will increase capacity and provides rapid, safe, effective and affordable healthcare sustainably within health workforce and resource constraints. (15)

Surgery and allied were aware of all Robotic surgeries including robotic trans oral, Renaissance spinal surgery, and significantly aware of DaVinci/LASIK and LASIK with the (p value of 0.009). Robotic surgery applies actuators and computer control into all surgical specialties with an overarching aim to combine a minimally invasive approach with improved surgical precision and accuracy. Robotic surgery pushes the frontiers of innovation in healthcare technology towards improved clinical outcomes. The innovative impact of this technology holds the potential to achieve transformative clinical improvements. However, despite over 30 years of incremental advances it remains formative in its innovative disruption.(16)

Other specialties have now hopped on to the robotic bandwagon. India now stands at the cusp of a robotic revolution. Robotic surgery in India is here to stay and it is up to us as minimally invasive surgeons across different specialties to lead the way and make maximum use of robotic surgery.(17)

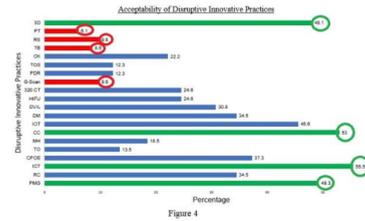
Medicine and allied specialties were more aware of Pulse Dose Rate (PDR) Brachytherapy (with p value of 0.005). Balgobind BV et al justifies the significant association between Medicine and allied specialties and PDR brachytherapy found in the study. PDR has been applied in almost all tumour sites for which brachytherapy is indicated and with good local control and low toxicity. PDR is a treatment modality that combines physical advantages of High Dose Rate (HDR) brachytherapy with the radiobiological advantages of low dose rate brachytherapy. Moreover, the main advantage of PDR is the ability to spare normal tissue, because of the small pulse sizes used. (18)

Acceptability

The overall acceptability as shown in (Fig 4) was highest amongst all for ICT (55.5%) and Cloud computing (53%). but surprisingly there was no significant association found statistically. This could be related to the study carried out by Westbrook et al which reveals that widespread adoption of ICT is a key strategy to meet the challenges facing health systems internationally of increasing demands, rising costs, limited resources and workforce shortages. Despite the rapid increase in ICT investment, uptake and acceptance has been slow and the benefits slower than accepted. (15)Today, ICT is changing the landscape of the world and leading us towards a sophisticated technical world. The emerging role of ICT has created a huge impact on Healthcare. (19) (Figure 4)

Table 3

Sr No	Demographic data	Variable	Size	Percentage	Innovative Practice	p-value
1	Age	<35 years	(n=41)	38.68%	-	-
		36-45 years	(n=31)	29.24%	-	-
		>45 years	(n=34)	32.08%	-	-
2	Gender	Males	(n=76)	71.69%	Cloud-Computing	0.023
		Males	(n=76)	71.69%	Da-Vinci	0.026
		Males	(n=76)	71.69%	320 Slice CT	0.028
		Males	(n=76)	71.69%	True Beam	0.029
		Females	(n=30)	28.31%	Robotic oral surgery	0.017
		Females	(n=30)	28.31%	Digital Mammography	0.011
		Females	(n=30)	28.31%	HIFU	0.003
		Females	(n=30)	28.31%	Retail Clinics	0.011



The overall acceptability was better for Personalized Medicine (49.3%) and 3D Printing (48.1%). This obviously states the fact that only those Disruptive Innovative Practices can be acceptable, which the respondents are aware of. This finding is in consonance with another study carried out which reveals that it is often assumed that increased present-focused awareness will necessarily occur with an attitude of enhanced acceptance. (20)

The acceptability as shown in (Fig 4) was poor for Proton therapy (6.1%), Renaissance (9.8%) and poorest for True Beam (8.6%) in spite of relatively better awareness (41.9%). This is confirmed by the study which reveals that the degree to which changes in either component i.e. awareness and acceptance tend to impact changes in the other is an open question, and it should not be assumed that the two components are inextricably linked. For example, high levels of awareness need not be accompanied by high levels of acceptance.(20) The reason could be attributed to the cost-effectiveness of these practices.

The cost of penetration of such innovations may be too high in the absence of prospective clinical data. The lack of sufficient evidence might also be owing to a too long restriction of Proton Beam facilities to physics research facilities. We therefore support a reasonable increase of proton therapy facilities within the context of academic centres. That is the way to go towards a cost-efficient and evidenced-based use of Proton Beam radiotherapy. (21) Despite tremendous enthusiasm about the modality's potential, concerns about high costs as well as the lack of comparative data have prevented it from solidifying its place in the radiation therapy armamentarium. (22)

Because the risks associated with spine surgery are plentiful, and limiting complications is imperative, implementing a robot-assisted technique has the potential to address many concerns associated with conventional surgery. The cost-effectiveness of robotics in spinal surgery to be carefully reviewed as it is likely to play an important role in its eventual assimilation into everyday practice. This is of particular importance in the multibillion-dollar spine surgery industry.(23) Despite the hype, however, there remains little market penetration, with affordability and the degree of value-added by such technology representing significant barriers to complete disruption of standard practice.(24)

Despite the growing body of clinical Stereotactic surgery and Stereotactic Body Radio Therapy literature, there is limited research into the cost-effectiveness and health economic outcomes of these procedures. Our long-term goal is to develop valid health economic research on SBRT and SRS. (25)

The association of demographic variables with acceptability of Disruptive Innovative Practices is shown in table 3. The following table shows the statistical association and its analysis revealed many significant associations between the awareness of Disruptive Innovative Practices and its acceptability.

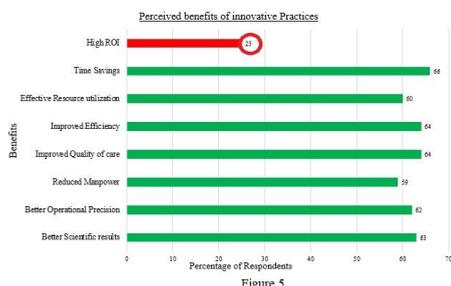
3	Job-profile	Faculty	(n=39)	36.79%	-	-
		Residents	(n=67)	63.21%	-	-
4	Job-experience	< 10 years	(n=51)	48.11%	-	-
		11-20 years	(n=25)	23.58%	-	-
		>20 years	(n=30)	28.31%	-	-
5	Specialty	Diagnostics & allied	(n=27)	25.47%	Tele-Ophthalm	0.032
		Diagnostics & allied	(n=21)	19.81%	320 Slice CT	0.041
		Para-clinicians	(n=33)	31.14%	MHealth	0.020

The males were more acceptable to Cloud computing, Da-Vinci, 320 Slice CT and True Beam (with p values of 0.023, 0.026, 0.028 and 0.029 respectively) and females were keener to accept Digital Mammography, HIFU, Retail Clinics and G Scan MRI (with p values of 0.011, 0.003, 0.011 and 0.05 respectively). (Table 3) The authors have also revealed that gender influence the causal relationship i.e. the path from perceived usefulness to attitude is much stronger for males as compared to females and the result is same for the path from ease of use to perceived usefulness.(9)

Diagnostic specialty was keener to accept Tele-Ophthalmology and 320 Slice CT with (p values of 0.023 and 0.045 respectively) whereas MHealth was significantly acceptable to Para-Clinical specialty (with p value of 0.009).

It was also found that though the awareness for Robotic surgeries amongst Surgery and allied specialties was better, its acceptability in everyday practice was not so striking. The findings of Ashrafiyan H et al correlates with the study. Training and adoption of evidence-based robotic approaches and gaining experience and confidence in the skills necessary for managing the complexities and complications of patients undergoing robotic surgery. These factors all require underpinning with the highest levels of evidence to develop the optimum multi-disciplinary approaches to integrate surgical, anaesthetic and allied specialties to deliver robotic surgery into its next stage of innovative evolution.(16)

As shown in the (Fig 5) more or less all benefits were perceived equally however on the top were time savings (66%), improved quality of care (64%), improved efficiency (64%) and better scientific results (63%). Interestingly the respondents were not sure of the return on investment (ROI) with the adoption of these practices. (Figure 5)



The significant association in between the Innovative Practices and its perceived benefits was analysed. The following table shows the statistically significant association between the Innovative Practices and its perceived benefits. The association between Disruptive Innovative Practices with its perceived benefits is shown in table 4.

Table 4

Sr No	Innovative Practice	Size	Percentage	Perceived benefits	p-value
1.	Internet of things	(n=42)	39.62%	Effective resource utilization	0.006
2.	Cloud Computing	(n=41)	38.67%	Improved Quality of care	0.035
		(n=39)	36.79%	Improved efficiency	0.002
3.	Digital Mammography	(n=46)	43.39%	Improved efficiency	0.011
4.	Da-Vinci	(n=54)	50.94%	Improved efficiency	0.023
5.	HIFU	(n=39)	36.79%	Improved Quality of care	0.038
		(n=67)	63.21%	Better scientific results	0.049

6.	320 Slice CT	(n=51)	48.11%	Better scientific results	0.038
7.	G-Scan MRI	(n=35)	33.01%	Improved Quality of care	0.016
		(n=42)	39.62%	Time savings	0.023
8.	PDR Brachytherapy	(n=37)	34.90%	Time savings	0.045
9.	Cyber Knife	(n=66)	62.26%	Time savings	0.009
		(n=40)	37.73%	Reduced manpower	0.011

The Internet of Things (IoT) was significantly associated with effective resource utilization (with p value of 0.006). Jadhav et al reported that IoT is a system to which innumerable smart gadgets are associated, and in the end incorporates the objective world with the information world for the benefits of end-users. IoT is able to greatly improve the resource utilization of smart devices and promote the harmony between man-made and natural environments. (26)

Cloud computing was associated with Improved quality of care (with a p value of 0.035) and Improved efficiency (with a p value of 0.002). These findings were resembling to the study Cloud computing an opportunity of healthcare. The article states that Cloud computing improves the quality and efficiency of care while cultivating patient centricity by overcoming challenges in the implementation of electronic medical records, promoting collaboration within and among care teams, and integrating secure, trusted information for analytics, evidence-based decision support and personalized care.(27)

High-intensity focused ultrasound (HIFU) was associated with Improved quality of care (with p value of 0.049). Cancer-related pain can negatively affect patient survival by directly reducing the quality of life causing a decline in the patient's overall health. Although there has been progress in the management of cancer-related pain, the current treatments still often have limited effectiveness. The main benefit of HIFU for patients with cancer is the capability to address different features of a malignancy namely, by way of decreasing painful stimuli, locally controlling the tumour, potentially enhancing local drug delivery, and stimulating the host antineoplastic immune response. All of these factors can contribute to a substantial improvement in the quality of life of patients with cancer.(28)

HIFU was associated with Better scientific results (with p value of 0.038). Its better precision effectively destroying the target tissue with lesser chance of doing damage to surrounding areas & nerves. No scatter effect on healthy tissues. Moreover, this procedure is non-invasive, and the absence of ionizing radiation ensures that there is no radiation-related risk if retreatment is deemed necessary after the recurrence of symptoms or worsening of the primary condition.(28) All of these factors contribute for the better scientific results of HIFU.

Improved Quality of Care was associated with 320 Slice CT (with p value of 0.049). This could be attributed to a study conducted which revealed that expansion of multi-slice CT systems from 64 to 128,256 and 320-slice systems has allowed for the accurate assessment of stenosis severity and atherosclerotic plaque composition, or even the acquisition of whole-heart coverage in one gantry rotation. (29)Owing to this it is simple, painless, super-fast and scans the heart in half a second and whole body in less than a minute. The shorter scan time provides comfortable breath holding, making this procedure ideal for people of all ages.

Better scientific results were associated with 320 Slice CT and (with p value of 0.038) as it is more accurate than the 64 Slice CT scan due to its superior image quality. This has been reported in a recent study that high diagnostic value, in particular a negative predictive value of 100% (including the non-diagnostic images), and diagnostic accuracy of 95% were achieved with 320-slice CT angiography for detection

of >50% coronary stenosis on a patient-based analysis. (29) Another study shows that 320-row CT is a robust and feasible method suitable for comprehensive primary imaging work-up of acute neurological patients. It also shows that this novel technique is able to deliver additional diagnostic information relevant to the patient's clinical state that would not have been available by standard CT scanning. (30)

Improved efficiency was associated with Digital Mammography (with p value of 0.011). The study has confirmed that diagnostic accuracy with Digital Mammography is significantly better than that with screen/film for subgroups of patients. The improved sensitivity of Full Field Digital Mammography is expected to lead to improvements in long-term outcomes. (31)

Improved efficiency was associated with DaVinci (with p value of 0.023). This could be attributed to the technical advantages which includes the potential for better visualisation with stereoscopic views, elimination of hand tremor allowing greater precision and improved manoeuvring as a result of the 'robotic wrist'. This in turn improves ergonomics that extend the surgical ability to perform complex technical tasks in a limited space. Here the surgeon is able to work with less stress, achieving higher levels of concentration. (16)

PDR Brachy therapy if adopted was found to be significantly associated with time-savings (with p value of 0.038). These findings can be confirmed by a white paper which reveals that shorter treatment times with brachytherapy provide convenience and limit disruption to patients' lives. Brachytherapy's mode of action 'from the inside, out' enables it to deliver the high treatment doses needed to kill tumour cells over a short time period. This allows for much shorter overall treatment than with EBRT or surgery. (32) (Table 5)

G Scan MRI if adopted was also found to be significantly associated with time-savings (with p value of 0.016). This finding is confirmed by the study done by Hall et al. A primary advantage of the method is its fast and accurate reconstruction, while using positional MRI to evaluate lumbar spine under proper orientation of gravity and a large range of motion without exposing the participants to ionizing radiation. This vertebral reconstruction method provides a systematic approach with accuracy, reliability, and efficiency. (33)

Cyberknife was significantly associated with time savings with a (p value of 0.020) and reduced manpower (with a p value of 0.011). The study findings correlate with the benefits of CyberKnife where in enhanced precision in treatment without incision and anaesthesia thus making it an out patient procedure thereby reducing the treatment times with little or no recovery times thus allowing patients to return to daily living directly following the treatment. (34)

Limitations

The findings of the study are subject to few limitations. First, this study was conducted at only one hospital and may not be representation of other medical institutions. Secondly, respondents answered questions based on their perceptions, experiences and understanding. Thus, data collected may not be adequately objective. Thirdly, responses of those who did not participate remained unknown. Fourthly, we studied heterogeneous population, hence can not generalise our findings to one particular group.

DISCUSSION

Disruptive Innovations in healthcare have the potential to provide better operational precision, which improves scientific medical results and helps to enhance return on investment (ROI). When making key decisions on procurement it is critical to hold extensive stakeholder discussions in the pre-implementation phase and follow through to the creation and nurturing of user support groups for introduction of any activity. (2)

The results of these studies present evidence to suggest that technological solutions alone will not lead to greater acceptance of Innovative Practices. Respecting that a system needs to be not only usable (i.e. technically sound) and useful (fulfilling the needs of users, organizations and/or patients), but it also needs to be appropriately introduced by organizations (through engaging with, training and responding to the needs and expectations of relevant stakeholders) might lead to increased acceptance. (2)

Disruptive Innovations in healthcare have the potential to provide

better operational precision, which improves scientific medical results and helps to enhance return on investment (ROI). When making key decisions on procurement it is critical to hold extensive stakeholder discussions in the pre-implementation phase and follow through to the creation and nurturing of user support groups for introduction of any activity. (2)

Considering the high cost of introduction of rapidly advancing Disruptive Innovations, it would be prudent for Healthcare managers to carry out a survey of those practices which are most acceptable to the clinicians as well as administrators. The administrators view has been obtained to ascertain the administrative benefits envisaged through Innovative Practices. Further, implementation will require to predict ROI and ensure training of HCWs on the use of new technologies.

Finally, action means translating awareness and acceptance into intentional responses rather than ill-conceived reactions. Intentionality here means consciously working to prevent misconceptions from blocking understanding and productive engagement. (35)

CONCLUSION

The results of these studies present evidence to suggest that technological solutions alone will not lead to greater acceptance of Innovative Practices. It also highlights the challenges in adoption of these practices because of lack of awareness therefore appropriate publicity and continuing medical education be done to improve awareness. It also brings to the fore lack of acceptability despite the appreciable level of awareness and optimism about the practices because of high cost. These goals can be achieved by exerting deliberate efforts to promote usage of affordable practices and ensuring training of HCWs on the use of new technologies.

This study also showed that the awareness of Innovative Practices to be low, despite the idea being acceptable to them, which calls for action to improve awareness by using more information, social marketing strategies, peer education and encouragement to take up these practices. The information given should be tailored to the level of awareness.

Considering the high cost of introduction of rapidly advancing Disruptive Innovations, it would be prudent for Healthcare managers to carry out a survey of those practices which are most acceptable to the clinicians as well as administrators. The administrators view has been obtained to ascertain the administrative benefits envisaged through Innovative Practices.

What was already known on the topic

First, these technologies represent the next wave of quality patient care techniques and deserve our research attention. Second, the developers of these innovative practices often act as the evaluators and thus give too little consideration to the negative impacts' technologies can have on patients and healthcare organizations.

What this study added to the knowledge

This study provides foresight information in availability of end-user support to help minimize potential adverse effects whilst at the same time maximize the chances of successful integration with individual workflows and organizational requirements in order to overcome the upcoming challenges.

By paying attention to these new technologies we can better inform the development of adoption techniques by identifying those Innovative Practices which are acceptable.

However, as options for various available innovative practices continue to increase, it is important to balance the perceived benefits of practices to patients and healthcare providers against their adoption in healthcare organization.

Future Research

Further, implementation will require to predict Return on Investment. As the respondents were not sure of the ROI in adopting these technologies, Cost-Benefit analysis of the Innovative Practices may be carried out in the future. Furthermore, cost-effectiveness analysis should be performed to better assess the real costs and benefits of using these technologies, as it is highly possible that the initially relatively high costs will result in lower long-term expenses and an overall

decrease in health care costs.

The demographic association of the Innovative Practices and the benefits perceived may also be carried out to identify the reasons behind adopting these practices.

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